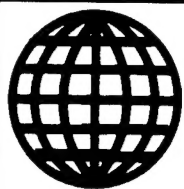


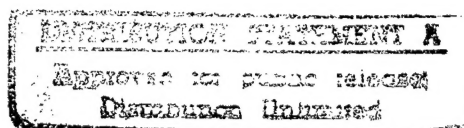
JPRS-UEE-90-006

17 JULY 1990



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# ***JPRS Report***



# **Science & Technology**

## ***USSR: Electronics & Electrical Engineering***

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# Science & Technology

## USSR: Electronics & Electrical Engineering

JPRS-UEE-90-006

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### **A New Approach to Television and Television Sound Broadcasting Networks**

907K0051B Moscow ELEKTROSVYAZ in Russian  
No 9, Sep 89 pp 18-21

[Article by V.N. Akhtyrskiy, N.Ye. Fadeeva, T.V. Mineeva, I.V. Nosov]

[Abstract] A method has been developed for establishing a computer-aided frequency planning system which can be used to frequency channel distribution within a regular, homogeneous network consisting of 900 transmitters. The computer-based system has also been used to run simulations aimed at optimizing the frequency plan for a section of an existing network. This section contained 350 stations (981 transmitters) in the European section of the USSR covering a territory of 2,736 thousand square kilometers. A new frequency plan for this area was developed as a result of the analysis. The computer experiments run in this case indicate the possibility of using the computer-based frequency assignment system developed on the basis of coordination rings in this study to review existing frequency plans, to optimize such plans, and to establish new assignments when new bands are incorporated.

### **The Fixed Satellite Service for Europe and Asia**

907K0152A Moscow RADIO in Russian No 12, Dec 89  
pp 4-9

[Abstract] This study is a survey of the coverage areas, frequency bands, and services provided by fixed satellite services in Europe and Asia. At present such systems operate in the 2.6-2.7, 10.7-11.7, and 11.5-12.75 GHz bands. The article reviews data on satellites whose signals can be received within the USSR. Such satellites are not intended to service areas in the USSR and their repeater frequencies overlap those of ground-based services and hence both interference will vary as well as reception conditions. Schedules of frequency assignments, programming and satellite locations are provided. Maps indicating the ground trace points of service satellites are provided for the "Astra", the "Intelsat", and "Arabsat" spacecraft.

### **A Digital "Magnetic Tape Recorder"**

907K0152B Moscow RADIO in Russian No 12, Dec 89  
pp 22-26

[Article by I. Nikiforov]

[Abstract] A digital "magnetic tape recorder" is being used in amateur radio communications for support of meter-band communications at transmission speeds between 420 and 2000 characters per minute. The unit combines many of the advantages of analog recording (including human hearing response during reception which is important in interference condition and the capacity to determine the transmission speed of another operator in a common calling mode) with the advantages

of digital recording (the tape recorder employs a narrow-band filter and is also capable of instantaneous and automatic switchover to a playback mode after recording and vice versa). The recorder consists of a transistorized analog-to-digital converter, a signal envelope "recovery" unit, a variable clock generator, memories, and controllers as well as a tone generator. The specifications of the unit are also given for both the 600 and 1200 switch positions.

### **A Universal Interface for "Consul"**

907K0152D Moscow RADIO in Russian No 12, Dec 89  
pp 37-42

[Article by V. Sugonyako]

[Abstract] A universal interface design for the "Consul" printer commonly used in amateur radio communications in the Soviet Union consists of two independent devices in a single unit: an independent keyboard unit and a printer mechanism. The interface discussed in the present article provides hardware and software compatibility between the "Consul-260" and the "Radio-86RK" amateur radio computer. In addition to a block diagram of the interface and a schematic of its component parts the article provides a description of program support and a program listout. A board wiring diagram and pin configuration is also provided.

### **"Mikrosha" is Equivalent to "Radio-86RK"**

907K0152E Moscow RADIO in Russian No 12, Dec 89  
pp 46-52

[Article by G. Zelenko, D. Gorshkov]

[Abstract] Minimal or no modifications must be made in the "Mikrosha" computer with Monitor in order to make it possible for the owners of the computer to utilize the rather extensive software available with the "Radio-86RK" computer. The two computers have similar hardware and software configurations and common connections. The "Mikrosha" has different programmable LSIC addresses. The pin configurations of the integrated circuits requiring modification and signal trace paths are given to facilitate user modification. Program compatibility between the two computers can be achieved by installing an additional ROM with a new Monitor. The ROM codes are provided in the article as well as the appropriate pin modification required for its installation.

### **Applications of the K155 Series Integrated Circuits**

907K0152G Moscow RADIO in Russian No 12, Dec 89  
pp 78-80

[Article by S. Alekseev]

[Abstract] The designs and applications of six integrated circuits within the K155 integrated circuit series are

discussed: the K155LN6, K155LP10, and K155LP11 integrated circuits in plastic packages and the KM155ID11, KM155ID12, and KM155ID13 integrated circuits in 16-pin metal-ceramic packages. In these integrated circuits a +5 V level is applied to pin 16 with pin 8 as the common pin. The K155LN6 integrated circuit contains 6 power inverters and can switch outputs into a high impedance state (a z-state). The K155LP10 integrated circuit includes six power followers whose outputs can also be switched into a high impedance state. The control logic, load capacity, and average signal delay times in this integrated circuit are identical to those of the K155LN6. Power consumption in this circuit is less than 85 mA. The K155LP11 also contains six power followers although these followers are divided into two groups, each of which has its own control input. The primary application of these integrated circuits is alternate signal injection from different sources into a single transmission line. The KM155ID11 integrated circuit is a binary code signal converter for conversion into a continuous voltage set for linear scale control. The KM155ID13 has the same inputs and outputs as the KM155ID11 although its operating logic is different.

#### **Opto-Mechanical High-Speed Photography Systems Manufactured in the USSR**

907K0141A Moscow *ZHURNAL NAUCHNOY I PRIKLADNOY FOTOGRAFII I KINEMATOGRAFII* in Russian Vol 34, No 6, Nov-Dec 89 pp 428-438

[Article by A.S. Dubovik, N.M. Model, V.V. Trofimenko]

[Abstract] Opto-mechanical high-speed photography systems are currently manufactured in the USSR. The study contains the design principles, specifications, performance, and applications of the commercially-manufactured systems. The equipment reviewed includes the 3KSU high-speed motion picture camera used for popular science, documentary, and artistic filming, the 1 SKL-M "Temp" camera designed for documentary, popular science, and other wide-screen format films in both black and white and color, and the following high speed motion picture cameras employing prism or mirror compensation of film motion: the PUSK-16 camera and the SK-2 camera. Photographs, specifications, design features, and applications of the latter two cameras are given. The study also covers high-speed motion picture and moving image cameras employing rotating mirrors. These units include the VFU-1 high-speed camera system, the VSK-5 high-speed universal camera system, and the VSK-6 high-speed universal camera system. Other cameras and film recording systems reviewed here include the ZSKh-1 chronograph, the ZSFK-2 camera, the ZEVS-K camera, and the ZEVS-R chronograph.

#### **A Fiber-Optic Differential Refractometer**

907K0140A Moscow *PRIBORY I SISTEMY UPRAVLENIYA* in Russian No 12, Dec 89 pp 22-23

[Article by S.A. Khurshudyan, M.Ya. Mesh, N.V. Rasshchektaeva, A.L. Shlifer, G.A. Yudin, G.A. Abzianidze]

[Abstract] A fiber-optic differential refractometer is used in measuring the refractive index differential of liquids as well as quality control and compositional analysis of industrial liquids and fluids. This unit consists of an optoelectronic unit and a cell optically connected by means of a monomode optical fiber and a multimode optical fiber. A monomode radiation source is connected to the monomode optical fiber and radiation passing through the cell is guided to a photodetector through the multimode optical fiber. The photodetector signal is then sent to a measurement device. Two effects therefore will effect the intensity of radiation transmitted through the multimode fiber for measurement purposes: a movement or change in the angle of incidence of the radiation on the optical fiber face, thereby determining the information signal formation mechanism. The study also derives the appropriate analytical relations which are used as the basis for identifying the primary effect behind the static response characteristic of this differential refractometer. Experimental tests were also carried out on the device using a helium-neon laser as the radiation source and an FD-6S photodiode with a preamplifier as the photodetector. The light-to-electrical voltage conversion factor was .14 V/mcW. The output natural noise level of the amplifier was less than 3 mV. Test results suggest that it is possible to fabricate a fiber-optic differential refractometer that can be used in strong electromagnetic fields, in the presence of radioactivity, etc. Optimization of the apertures of the multimode optical fiber and the exit lens can be used to virtually eliminate the effect of changes in the refractive index angle on measurement error.

#### **Automatic Caller-Based Sorting and Recognition Device**

907K0140B Moscow *PRIBORY I SISTEMY UPRAVLENIYA* in Russian No 12, Dec 89 pp 24-25

[Article by L.B. Bagdasaryan, O.I. Moskalenko, V.I. Pavlov, T.V. Rykalina]

[Abstract] This article develops the design, operational algorithm and functional concepts behind an automatic color-based sorting and recognition device used in industrial quality control for agroindustrial sorting and identification applications. This device is designed to measure the chrominance coordinates of traveling objects and to calculate the sign of a derived equation using given fixed reference coefficients. This sign will define the domain of object color relative to the appropriate chrominance curve. The device operates as follows. The light from the light source impacts the object traveling on a conveyor belt and is detected after reflection by a color detector whose photocells produce voltages proportional

to the spectral reflection functions which are sent to a decision unit. The unit then calculates the chrominance coordinates and the calculation sum; reference coordinates from a program sorting unit are then utilized. The device is suitable for color-based object recognition and sorting by employing the appropriate actuating mechanisms. The unit has passed acceptance tests and is currently commercially manufactured at an experimental factory of the "Pishchepromavtomatika" scientific production association in Odessa.

#### **Combined Analog-Digital Signal Interface for Control Objects**

907K0140C Moscow PRIBORY I SISTEMY  
UPRAVLENIYA in Russian No 12, Dec 89 pp 27-28

[Article by M.P. Tsygankov, Ye.V. Gordeev]

[Abstract] This article discusses the design, specifications, and application of a general purpose combined analog-digital signal interface employed in industrial distributed control systems for direct input of analog and digital signals to a computer. The device performs multichannel level and time monitoring of two-level pulsed sequences and can be used to input all such parameters through a single computer or controller port, thereby avoiding duplication of interface functions, substantially reducing hardware outlay and reducing power consumption while improving functional reliability. The input signals are generated by a wide range of transducers including pulse-width, time, phase, and frequency modulation sensors and transducers. The unit is based on a programmable microcomputer and includes NP1-NP16 transducers and a data acquisition interface module. Level shift circuits and an amplifier-attenuator together with a Schmitt flip-flop and frequency dividers are used as the normalizing transducers for pulsed and harmonic signals. A pulse width modulation transducer is used for

analog signals. Special software can be used to modify the input channels to accept signals of a specific type and to calculate relative information parameters. The unit is employed in a local industrial control system used in commercial carbon production.

#### **Digital Signal Distortion Analyzers**

907K0112B VESTNIK SVYAZI in Russian Vol 34  
No 6, Nov-Dec 89 pp 33-34

[Article by A.S. Adzhemov, V.V. Druz, A.I. Koblents, R.A. Khalidov]

[Abstract] This study is devoted to an analysis of two static distortion analyzer implementations for use in frequency-division multiplexed data transmission systems. One implementation is a hardware-based design that employs the IKI-ZU-IV analyzer and is used to measure arrival curve distortion, and start-stop distortion for 1:1, 1:3, 3:1, 1:7, 7:1, and "test" signals. The second implementation is a software analyzer based on the "UOU-Elektronika-580" microcontroller which is used to measure signal element duration distortions for 1:1 and "TEKST" test signal utilization. The software implementation includes a microcontroller, a parallel port designed to analyze the input signal, and to perform coding of the multiplexer and demultiplexer; a first timer used to determine distortion level and produce a reference signal; a serial port for output of measurement results; a second timer which produces the clock frequency; a tape recorder used to store program texts and record measurement results for subsequent automated processing; a multiplexer and demultiplexer used for internal switching of input and output signals; telegraph switches and a telegraph for printing measurement results. The digital signal distortion analyzers were found to be effective for use on frequency-division multiplexed communications channels.

UDC 621.391.037.372

**Synthesis of Algorithms for Fast Vector Quantization of Signals**

907K0150A Kiev IZVESTIYA VYSSHIKH  
UCHEBNIKH ZAVEDENIY: RADIOELEKTRONIKA  
in Russian Vol 32, No 12, Dec 89 (manuscript received  
14 Mar 89) pp 28-34

[Article by V.N. Ivanov and A.A. Lanne]

[Abstract] A method of constructing algorithms for fast vector quantization of signals with maximum noise immunity in terms of signal-to-noise ratio is proposed, this method being based on divisibility of the code book. It involves construction of a family of dividing planes, each definable by its expanded normal vector and partitioning the Riemann space  $R^n$  into two half-spaces. The concept is applied to code books containing  $L = 2^N$  elements, such a book not being linearly divisible when  $N$  is equal to or larger than  $n+1$ . In order to construct the classifier for this case, it is necessary to map the vectors of the planes onto a space of dimensionality  $M$  equal to or larger than  $N$ . The other possibility is constructing a hierarchical classifier. A classifier of random sequences is realizable when  $N$  is equal to or smaller than  $n$ . A divisible code book is formed on the basis of some initial set apriori known to be divisible. Classifiers have been constructed by this method for fast vector quantization of signals subject to three typical distortion measures: (1)  $d_1(x,y)$ , (2) scalar product  $d_2(x,y) = \sum_{i=1}^n x_i y_i$  from  $i=1$  to  $i=n$ , (3) absolute value of scalar product (2), the optimality criteria for vector quantization, or in this case vector-scalar quantization, having been  $d = \min D(q)$  for case (1) and  $d = \max D(q)$  for cases (2) and (3). Here  $d(x,y)$  is the proximity function characterizing the proximity of vector  $x$  to another book element  $y$  and  $D(q) = E[d(x,y)]$  is the quantization error. The method is suitable for synthesis of a vector quantizer of minimum complexity for a known probability density  $p(x)$  and prescribed noise immunity level, but so far only in special cases such as a Gaussian signal source without memory or other signal sources with uniform probability distribution density. Figures 4; tables 3; references 7.

UDC 681.325.5:621.391

**Synthesis of Digital Nonrecursive Filters on TMS32010 Digital Signal Processor**

907K0150B Kiev IZVESTIYA VYSSHIKH  
UCHEBNIKH ZAVEDENIY: RADIOELEKTRONIKA  
in Russian Vol 32 No 12, Dec 89 (manuscript received  
14 Mar 89) pp 58-60

[Article by O. B. Semenov]

[Abstract] Four methods of synthesizing digital nonrecursive filters on the TMS32010 special-purpose digital signal processor are described, for a comparative evaluation with respect to hardware and software requirements and also time economy. The algorithm of  $N$ -th

order nonrecursive filtration is  $y(n) = \sum_{k=0}^{N-1} x(n-k)h(k)$  from  $k=0$  to  $k=N-1$ , where  $x(n-1), \dots, x(n-N+1)$  are the delayed input readings. The first method of synthesis, the simplest and most economic one using only the internal data storage, involves initiating operation of both input and output devices by decoders of DEN-dash and WE-dash signals and of the three lower digits on the address bus. The relatively small storage capacity limits this method to filters of not higher than 140-th order. The second method involves use of an external data storage occupying a part of the address field, data exchange between the program storage and the data storage in response to TBLR and TBLW commands being facilitated by modification of the Harvard architecture. It requires only slightly more complex hardware but an entirely different software than the first method, but its capability is much broader. The third method involves expansion of the internal data storage by addition of another random-access memory and thus without occupying any part of the address field, addressation of this additional memory being effected through a reversible address counter. The fourth method, an extension of the third one with expanded internal data storage, includes automatic shift of delayed filter input readings in the external data storage. Tables 1.

UDC 621.372.542

**Estimation of Quantization Noise in Fast-Fourier-Transform Computing Devices of K1815VFZ Microprocessor**

907K0150D Kiev IZVESTIYA VYSSHIKH  
UCHEBNIKH ZAVEDENIY: RADIOELEKTRONIKA  
in Russian Vol 32 No 12, Dec 89 (manuscript received 1  
Aug 88) pp 61-64

[Article by V.I. Bityutskiy, V.A. Kozmin, and S.S. Ryazantsev]

[Abstract] Quantization noise in Fast-Fourier-Transform computing devices and particularly in those of the K1815VFZ microprocessor is estimated, its principal source being truncation of numbers in the product registers during multiplication of signal readings by rotator multipliers and during scaling to prevent overflow of the sum registers. A processor using the 1,0,-1 numeration system is considered for calculation of fast Fourier transforms with a sparse frequency grid. Elements of multiplication noise and scaling noise are indicated on the butterfly circuit diagram. The dispersion of each noise is calculated in that sign-and-binary numeration system and, for comparison, also in the plain binary one. The ratio of quantization noise to computer output signal during scaling at the inputs of the butterfly circuits is then determined and with it the number of digits in the registers necessary for this ratio not to exceed the permissible value, this number depending on the number of stages of the fast Fourier transformation. Quantization noise can be analogously estimated for fast Fourier transforms with a sparse time grid. Figures 2; references 2.

UDC 621.373.001.24:621.373-187.4

**Method of Analyzing Spectral Characteristics of Digital Multilevel-Signal Synthesizers**

907K0150E Kiev IZVESTIYA VYSSHIKH  
UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA  
Vol 32 No 12, Dec 89 (manuscript received, after  
revision, 10 Jan 89) pp 73-74

[Article by I.S. Ivanin]

[Abstract] Digital frequency synthesizers are described, this class of digital multilevel-signal synthesizers being based on approximation of the  $\sin x$  function with piecewise-constant Walsh functions. It consists of a digital phase storage which receives a reference-frequency signal and puts out Rademacher functions representing phases of the synthesized-frequency signal

along a ramp, a Rademacher-to-Walsh converter, a digital-to-analog converter which weights the Walsh functions and puts out a multilevel step signal, and a low-pass filter which extracts from it the synthesized-frequency signal. The cost of such a synthesizer depends on the required accuracy of the approximation. In order to design one, it thus becomes necessary to analyze the spectral characteristics of its output signal and to allow for variation of all design parameters influencing them. This requires ordering the basal system of Walsh functions, which is most expediently done in the Paley system because the Walsh-Paley spectrum converges fast and because the difference equations generating the Paley system are simple. Such an analysis, taking into account the filter capacity, indicates that suppression of parasitic components within the pass band of the filter requires the proper number of phase quantization levels (number of points defining the signal in terms of Walsh functions) and the proper number of amplitude quantization levels (bit capacity of the digital-to-analog converter). Figures 2; references 4.

### The Possibility of Increasing the Number of Channels on Existing Two-Channel Communication Lines

907K0060B Moscow AVTOMATIKA  
TELEMEKHNIKA I SVYAZ in Russian No 10, Oct 89  
pp 27-30

[Article by Ye.Ye. Golikov, N.I. Yakimov]

[Abstract] Modifications are proposed to expand the number of channels on existing two-channel communications lines used in railroad communications. In order to free up three physical circuits the authors propose converting the service communications facilities with few stations that are not used for communications (such as ticket sales office, transportation police, and car distribution services) to the channels of one of the transmission systems operating on this two-cable line. The authors propose using the OV-3-3 equipment for parallel branching of the communications channels at intermediate stations. A method is proposed for establishing branched service communications channels in a multichannel transmission system and the technique was tested on the Ulan-Udensk section of the Eastern Siberian Railroad on a two-cable line 340 km in length. The test results demonstrated the fact that this technique could be used to generate additional channels that satisfy all specifications and standards.

### ALS-EN Locomotive Signaling

907K0124B Moscow AVTOMATIKA,  
TELEMEKHNIKA I SVYAZ in Russian No 12,  
Dec 89 pp 9-11

[Article by D.A. Kogan, Ya.S. Spektor, A.S. Gryaznov]

[Abstract] This article is a continuation in a series of articles on the ALS-EN automatic locomotive signaling system. This article covers the BPFS power supply. Different specific requirements are imposed on the power supply based on operating conditions. The unit must be highly reliable under conditions of voltage surges from atmospheric electricity and be able to generate three stabilized d.c. voltage lines for the three-channel signal driver circuit. The BPFS unit itself is powered by a single-phase a.c. 50 or 60 Hz 220 or 230 V line through an external POBS-5A or SOBS-2A step-down transformer with a secondary voltage of 9.6 plus or minus 0.4 V and 17.5 plus or minus 0.5 V at currents below 5 and 15 mA, respectively. The article provides a block diagram of the hook-up configuration of the power supply as well as a schematic of the 142EN2B integrated circuit used for voltage control and regulation within the power supply. A schematic of the overall power supply is provided together with a listing of the resistor designations and nominal voltage, resistance, and current levels.

### The Remote Control System for the IKM-120A Secondary Digital Transmission System

907K0124B Moscow AVTOMATIKA,  
TELEMEKHNIKA I SVYAZ in Russian No 12,  
Dec 89 pp 11-14

[Article by V.P. Glushko, A.P. Koshelev, S.Ye. Kustyshchikov]

[Abstract] This article is one in a series of articles devoted to the IKM-120A secondary digital transmission system and focuses on the design and configuration of remote control in the IKM-120A equipment for application to continuous automatic monitoring of the primary equipment components on the line circuit, including repeater sections, attended and unattended repeater stations, and terminal stations. The remote control system includes equipment for both the principal remote control station and attended stations as well as unattended repeater stations. The principal station monitors the parameters of the attended and unattended stations. Each remote control segment is divided into sections each of which may include up to four regeneration stations or three unattended regeneration stations and a single terminal station. A diagram of the remote control distribution network for the IKM-120A secondary digital transmission system is provided together with a block diagram of the principal station layout, timing diagrams of remote control commands and types of signals transmitted to and from the principal stations.

### Special Design Features of Video Equipment for Rolling Stock in Railroad Transport

907K0124C Moscow AVTOMATIKA,  
TELEMEKHNIKA I SVYAZ in Russian No 12,  
Dec 89 pp 15-17

[Article by A.V. Shulzhenko]

[Abstract] This article discusses the special requirements and design features of video monitors (cathode ray tubes) used in railroad transport. The rigorous operating conditions, dynamic power loads, and exposure to powerful electromagnetic fields make it necessary to minimize the size, weight, and material consumption of video monitors as well as to shield and protect the units from external action. The article discusses several shielding and shock-absorption designs for cathode ray tubes used in railroad transport. One such design is a support for an electron-optical system within the video monitor housing itself. This device is a three-stage shock absorption system. The first stage includes a mount for the radio electronic equipment, a set of standard shock absorbers, and a housing for the video monitor; the second stage contains a video monitor housing, a console support platform, and the support frame for the electron-optical system; while the third stage provides the supporting frame for the electron-optical system, the cathode ray tube bulb supports, as well as the cathode ray tube bulb itself. A variety of designs and combinations of these three stages are discussed. The performance of the

various systems under different loading, vibrations, and electromagnetic field action is considered. Specific applications of the systems are discussed.

### The FU2 Phaser Railroad Transport

907K0124D Moscow AVTOMATIKA,  
TELEMEKHANIKA I SVYAZ in Russian No 12,  
Dec 89 pp 17-10

[Article by N.M. Belyaev, Yu.L. Masaytis, D.A. Kogan, Z.A. Etkin]

[Abstract] The heavy duty FU2 phaser is used to support normal operation of DSSH relays on railroad lines by setting the phase shift between the voltage on the local coil and the voltage on the rail coil. The unit is capable of operating with temperature variations from -60°C through +65°C. The FU2 can be connected to PCh50/25-40, PCh50/25-100, PCh50/25-150, and PCh50/25-300 frequency converters. The article provides a wiring diagram, nominal resistance, voltage and current levels and timing diagrams for phaser operation in such applications.

### A Railroad Car-Laboratory Test System

907K0124E Moscow AVTOMATIKA,  
TELEMEKHANIKA I SVYAZ in Russian No 12,  
Dec 89 pp 23-25

[Article by V.I. Kondrakhin]

[Abstract] The D3-28 computer is being tested and analyzed in a railroad car-laboratory measurement system on the Far-Eastern Railroad. The computer is used in the measurement system to preprocess information, to average measurement results, and print out final results in a convenient form. The high-capacity RAM in the computer permits storage of incoming information and can be used to print out information at scheduled times. The computer has a 32 K RAM. The approximate execution time for a single binary arithmetic operation is .02-.1 ms with an execution time for a decimal operation totaling 1-10 ms. Byte data swapping in a parallel code is used to interact with the computer peripherals. The test program run on the computer consists of three sections with only one section running at any time. The computer is used for such applications as traffic analysis, scheduling, and rolling stock distribution. Block diagrams of the rail sensor unit and the measurement system itself are provided.

### Tuning Technology for a Waveguide Cable Junction

907K0124G Moscow AVTOMATIKA,  
TELEMEKHANIKA I SVYAZ in Russian No 12,  
Dec 89 pp 32

[Abstract] An alternate waveguide cable junction tuning technique is to be used instead of the technique specified in the regulations, which is not suitable due to low signal

level. In this method the RK-75 coaxial cable is disconnected from sliding connector K1 of the first SK-6 matching circuit and is connected to connector K3 of the KSV junction cable which is connected to unit number two of the 42RTM-A2-ChM radio set. In order to tune the first matching circuit of SK-6 the RK-75 coaxial cable is disconnected from connector K2 and is connected to connector K3. Pressing SB applies voltage to unit number 2 and SK-6(1) is then tuned by capacitor C1 and is trimmed by coil L1 by dipping the reading from the standing wave meter. After SK-6 is tuned the RK-75 coaxial cable is disconnected from connector K3 and is connected to connector K2. This completes the recommended tuning procedure. The article provides both a block diagram of the appropriate components and a wiring diagram indicating nominal voltage levels.

### Automatic Telegraph Switchboard

907K0108A Moscow AVTOMATIKA,  
TELEMEKHANIKA I SVYAZ in Russian No 1, Jan 90  
pp 18-19

[Article by I. A. Petrovich, A. V. Maznoy]

[Abstract] This article reports the development of an automatic electronic switchboard for dispatcher use on certain facilities of the Byelorussian Railroad. The switchboard is based on an F1213 electronic teletype and is connected to a data transmission multiplexer used with a TAV line group on a two-pole telegraph channel or a physical line channel. Therefore only a single line is required with this switchboard to transmit messages on train arrivals and departures to all dispatchers in the division. At the dispatcher workstations the teletypes are connected to the automatic telegraph switchboard on a two-wire line (a current loop). The computer addresses each train message to a specific dispatcher. By analyzing the automatic answer-back the data remote processing system latches on an accompanying letter character to the message which is transmitted first in the message. This character is the code for the automatic telegraph switchboard. This code is used by the switchboard to connect to the line one of ten equipment sets at the dispatcher workstations. A complete schematic of the unit is provided together with a hookup diagram.

### Switching Programs for Personal Computers

907K0108B Moscow AVTOMATIKA,  
TELEMEKHANIKA I SVYAZ in Russian No 1, Jan 90  
pp 20

[Article by A. Ye. Zhuk]

[Abstract] This study reports the development of software for supporting information exchange using synchronous operational algorithms for the "Roboton-1715", the YeS-1840, and YeS-1841 personal computers used on the Byelorussian Railroad for automated transport management workstations. The programs support information exchange between the personal computers

and a YeS mainframe computer using the following media: a dedicated telephone channel, a point-to-point connection, a switched telephone connection, and a multipoint connection. The software is currently used at the computer center of the Byelorussian Railroad for information exchange between the personal computers and a standard data teleprocessing system via a yeS-1840 data transmission multiplexer. A TEM-1200 modem is also used.

UDC 656.25:621.35

### **Electromagnetic Influence of Traction Circuit on Main-Line Communications Cable Near BAM**

907K0091A Moscow AVTOMATIKA,  
TELEMEKHANIKA I SVYAZ in Russian No 11,  
Nov 89 pp 9-12

[Article by A. R. Sumin, Deceased]

[Abstract] The very difficult terrain conditions in several sections of the baikal-amur main line (BAM) required that major communications cables be routed with the railroad, buried in the road bed. The soil is a mixture of sand and pebbles, rocks and frozen rock, extending to some depth with resistivity  $10^3$  to  $20 \cdot 10^3$  Ohms  $\cdot$  m or more, causing great difficulty in providing protective grounding for the communications cable. Measurements were performed in this area of dangerous and interfering voltages in single- and two-wire circuits on the communications cable. The maximum traction current for a heavy train reaches 600 A in this region. The voltage induced between conductor and ground in the communications cable at this point approaches 600 V. The shielding effect of the cable envelope depends on the quality of the ground. The measurements showed that in most amplifier sections with pebble and rocky soil extreme measures must be taken to assure shielding of the cable. Along the BAM it is economically expedient to use the rails of the railroad as natural grounds for the communications cable. For the future, when the current on the traction network will increase to 1000 A, the requirements for protective effectiveness of the cable sheath will be still greater. In areas with ac electric traction and high resistivity of the soil where low temperatures are typical, expensive but ineffective artificial grounds should be avoided, using instead the rails of the traction network.

UDC 656.254.15

### **Method of Estimating Capacity of Local General Service Telephone Communications Network**

907K0091B Moscow AVTOMATIKA,  
TELEMEKHANIKA I SVYAZ in Russian No 11,  
Nov 89 pp 13-14

[Article by V. A. Prokofyeva, Candidate of Technical Sciences, K. L. Shaytenov, Engineer]

[Abstract] The existing method of calculating the number capacity of a railroad automatic telephone exchange, described in the instructions for design of the ATSK-100/2000 quasielectronic telephone exchange, is based on composition of subscriber lists for the next three years of operation of the planned exchange. This method, requiring detailed information on the structure of the staffing of the railroad station, is too cumbersome and fails to consider the influence of the quantity of work done at the railroad station on the number capacity of the exchange. This article presents a method for determining the capacity of the telephone exchange required at a railroad station on the basis of the volume of work performed at the station. Nomograms are presented for determination of the desired number capacity on the basis of the number of employees at the station, the number of workers of all railroad enterprises of the section and the entire railroad. A 25 percent reserve of unused numbers is suggested.

UDC 656.254.16:621.396.7:612.317.3

### **Automation of Train Radiocommunications Parameter Measurement**

907K0091C Moscow AVTOMATIKA,  
TELEMEKHANIKA I SVYAZ in Russian No 11,  
Nov 89 pp 31-33

[Article by V. V. Kavun, Department Chief, Radiocommunications, Signaling and Communications Service, Far Eastern Railroad, V. A. Snigur, Engineer, Railroad Automation, Remote Control and Communications Laboratory]

[Abstract] Laboratory cars of the Far Eastern Railroad utilize a system of automated testing of train radiocommunications parameters developed by the Khabarovsk Institute of Railroad Transport Engineering in cooperation with specialists of the railroad. The system automates the process of measurement and recording of the basic parameters of a train radiocommunications channel and assures high accuracy of measurement and timely visual monitoring as well as printed confirmation of results. The system is designed for measurement and recording of track position with an accuracy of 100 m, radio set number, calling frequency, frequency deviation and field strength. The system uses a telegraph set as a printer, allowing additional information and comments to be recorded as measurements are made. The individual components of the system are described and a functional diagram of the entire automated system is presented.

UDC 621.3.042:621.3.014.4

### **Equivalent Circuit Parameters of Eddy-Current Loops in Arbitrarily Configured Thick Segments of Magnetic Core**

907K0148C Novocherkassk IZVESTIYA VYSSIKH  
UCHEBNYKH ZAVEDENIY: ELEKTRO-  
MEKHANIKA in Russian No 10, Oct 89 (manuscript  
received 28 Nov 88) pp 65-71

[Article by V. V. Fetisov, doctor of technical science, professor, Leningrad Polytechnic Institute, and I. Yu.

Sedova, candidate of technical sciences, acting docent,  
Stavropol Polytechnic Institute]

UDC 621.372

[Abstract] Representation of eddy-current loops in massive segments of the magnetic core by an infinite chain of R-L loops inserted into the equivalent circuit is physically valid, but for the purpose of mathematical analysis it is more expedient to represent them by a purely inductive branch  $L_1$  and a stack of R-L branches in parallel with the main-flux inductance  $L_{\sigma 0}$ . Such a conversion from equivalent series circuit to equivalent parallel circuit is permissible only for long and narrow cores, however, where the inductance almost does not vary across the width. In the case of d.c. machines, where the magnetic cores have wide segments, the mathematical model which replaces the physical model of eddy-current loops must be valid for any width-to-length ratio. Such a model can be constructed approximately, the main problem being to achieve mathematical correspondence between the equivalent circuit with a finite number of branches representing eddy-current loops and the original one with an infinite number of such branches where it is physically valid to let the equivalent main core loss resistance  $r_0$  approach infinity and the eddy-current inductance  $L_1$  in parallel with it become equal to the main-flux inductance  $L_{\sigma 0}$ . This problem is avoided by insertion of an inductance  $L_2$  in series with the main-flux and eddy-current chain of loops prior to conversion into an equivalent parallel circuit. The number of branches representing eddy-current loops in the equivalent circuit necessary for calculation of eddy-current losses depends on both the frequency of flux variation and the required accuracy, the equivalent inductances and resistances depending on the width-to-length ratio of core segments. The results of calculation need to be corrected for inductance variation across the core width. Figures 9; references 3.

**Current Transducer for Rolling Stock Based on Semiconductor-Type Magnetic Field Probe**

907K0148D Novocherkassk IZVESTIYA VYSSHIKH  
UCHEBNYKH ZAVEDENIY: ELEKTRO-  
MEKHANIKA in Russian No 10, Oct 89 pp 80-82

[Article by Viktor Vasilyevich Litovchenko, candidate of technical sciences, docent, and Andrey Nikolayevich Sotnikov, junior scientific associate, Moscow Institute of Railroad Transportation Engineers]

[Abstract] A current transducer for accurate measurement of instantaneous current values without distortion in the presence of strong electromagnetic interference is described, such a device being required for automatic control of traction motors and this one also isolating the control circuit from the high-voltage circuits. It is based on a semiconductor Hall generator which includes a current-to-flux converter comprising a wound toroidal ferromagnetic core with an air gap, a flux meter, and an interference suppressor. A precision operational amplifier with a parallel differential pair of input stages and a difference output boosts the Hall voltage and attenuates the cophasal signal, its analog output signal being proportional to the measured current. Another operational amplifier converts voltage signals into current signals for transmission of vehicle data over a typically 20 m long communication line exposed to strong electromagnetic interference. A experimental prototype of such a current transducer was designed, built, and tested, its performance being found to quite satisfactory for the given application. Figures 2; references 2.

UDC 621.384.3:537.2

**IR-System Receiving Devices***907K0188A Moscow PRIYEMNYYE USTROYSTVA  
IK-SISTEM in Russian 1987 pp 2-3, 208*

[Book by P. A. Bogomolov, V. I. Sidorov, I. F. Usoltsev]

[Text] The physical principles, characteristics and theory of new generation infrared light receiving devices are presented: receivers based on charge-coupled devices and charge-injection devices, receivers with internal signal integration, pyroelectric vidicons. Significant attention is given to the conversion and reading of light signals in receivers both with internal processing of the primary signals and by means of microprocessor equipment and integrated microcircuits. An analysis by the authors of open foreign and domestic sources is used to provide a classification of heat-vision systems as to their purpose, and a description is presented of certain types of such systems (based on a new class of light receiving devices) for detection and recognition of objects based on their heat radiation.

The book is intended for scientific workers specializing in the area of infrared equipment. There are 11 tables, 103 figures and 120 bibliographic references.

**Foreword**

In recent years, IR equipment has been rapidly developed. This has resulted primarily from the appearance of a number of new technical ideas, allowing improvement in the operational characteristics of IR systems, simplification of their design and significant reductions in cost. The new ideas relate primarily to the basic element of a receiving system—the photosensor device. Following the creation of solid-state image signal generators operating in the visible area of the electromagnetic spectrum, multiple-element image receivers functioning on the basis of new principles have also been created for the IR band.

A natural result of the appearance of the new ideas has been a large number of publications on IR-radiation receivers of the new generation in the domestic and foreign scientific literature. The new trend in IR equipment has in recent years formed the subject of special international conferences and symposia. Scientific information on the creation of multiple-element receivers of the new generation can be found basically in journal articles and conference materials.

In this book, the authors, based on analysis of these publications, have attempted to reflect the level which has been achieved in the development of IR systems. Since the area of optoelectronics in question is in a state of rapid development, it is difficult to reflect the numerous trends in development of new photosensor devices. However, it is this very variety of ideas suggested and the absence in the domestic and foreign literature of a monograph analyzing these ideas from a

consistent standpoint and estimating the prospects for technical implementation of the ideas that determines the necessity of writing this book. It will allow specialists to make a scientifically well founded approach to evaluation of the range of problems which can be solved by IR equipment. The book also should allow specialists on IR equipment to become familiar with modern ideas and concepts which they have not previously encountered when working with traditional photosensor devices.

Primary attention in the book is given to multiple-element IR radiation receivers based on ideas new in principle for IR equipment. It is the transition to multiple-element receivers, supporting generation of higher information density in the focal plane of an optical system, which has represented the appearance of the new generation of receiving systems.

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### Application of the Ch6-71 Frequency Synthesizer in Measurement and Computing Complexes

907K0107A Moscow IZMERITELNAYA TEKHNICA  
in Russian No 12, Dec 89 pp 10

[Article by A. A. Chertoriyskiy]

[Abstract] The underlying operational algorithm of the Ch6-71 frequency synthesizer for use in measurement and computing complexes is discussed. This frequency synthesizer covers a broad frequency range with rather good operational specifications yet at the same time there is a complete lack of information on the operational algorithm and operation of the synthesizer within such systems. The article focuses on the output signal frequency and amplitude control algorithm of the synthesizer. Seven of the frequency bits are divided into pairs. Each pair of digits is assigned an ordinal number from zero from the least significant digit through three for the most significant digit pair corresponding to the frequency. Pair number four corresponds to a two-digit number equal to the attenuation level. The frequency synthesizer address is first transmitted. The synthesizer is then ready to receive information and sends the number through the interface corresponding to the pair of frequency bits whose values are to be changed. The frequency value corresponding to the bits is then transmitted. In addition to this operational algorithm, this article provides the pin assignment of the integrated circuits, an instruction set, and appropriate status codes.

### Ray Method of Measuring Three-Layer Optical Fibers

907K0107B Moscow IZMERITELNAYA TEKHNICA  
in Russian No 12, Dec 89 pp 16-18

[Article by A.B. Androsik]

[Abstract] Geometrical and optical properties of fibers are based on the scattering pattern produced by partial critical rays transmitted through one layer of a three-layer optical fiber. In this analysis the incident wave is decomposed into a set of ideal light rays of identical intensity at identical distances. Equations are derived for each of these rays which include: the ray reflected off the outer fiber surface; the ray penetrating the first layer and reflected off the second layer; the ray penetrating the second layer and reflected off the third layer; the ray penetrating all three layers with zero reflection; the ray striking the central layer, reflecting once and exiting; the ray striking the central layer, reflecting twice and exiting the optical fiber; the ray reflected off the second layer and the inner surface of the optical fiber and exiting this surface; the ray reflected off the second layer, the inner surface of the second layer and transmitted through the optical fiber; the ray reflected off the inner layer, the inner surface of the optical fiber and exiting the fiber, and finally the ray reflected off the inner surface of the fiber and then passing through the fiber. A computer analysis was run to analyze optical fibers of variable layer diameters and refractive indices. The error in

determining the scattering pattern by the ray method for optical fibers with such parameters was .821 percent compared to the diffraction technique using exact formulae.

### Iteration Method of Determining Natural Frequency of Electrodynamical Seismic Detectors

907K0107C Moscow IZMERITELNAYA TEKHNICA  
in Russian No 12, Dec 89 pp 34-35

[Article by E.M. Bromberg, A.Ye. Manokhin, O.S. Maksumov, V.I. Shlimak]

[Abstract] An iteration method of determining the natural frequency of electrodynamic seismic detectors is standardized by GOST 24391-80 to be within plus or minus 5 percent of the nominal value. This method involves exciting the test seismic detector by means of a harmonic current, subtracting from the seismic detector voltage the compensation voltage whose amplitude and phase are identical to those of the voltage across the seismic detector coil and then tuning to resonance with the current of the resulting difference voltage. The unit used to determine seismic detector frequency consists of a harmonic voltage generator, a voltage-controlled current source, the seismic detector mounted on a vibrating platform, a frequency meter, phase shifters, a differential amplifier, a voltmeter, and a phasemeter. Relative formulae are also given for the resonant frequency of the difference voltage used in the natural frequency calculation. The error of the iteration method calculated by the technique outlined above is .15 percent.

### An Automated Acoustical Interferometer

907K0107D Moscow IZMERITELNAYA TEKHNICA  
in Russian No 12, Dec 89 pp 41-43

[Article by S.P. Klimov, V.V. Tyutekin, A.Ye. Vovk]

[Abstract] This study focuses on the so-called two-point method of measuring the acoustical parameters of materials and structures by means of acoustical interferometers. The analysis specifically considers issues directly associated with measurement automation in the two-point method using a water-filled acoustical interferometer with the acoustic field under harmonic excitation between 100 and 5000 Hz. An "Elektronika-100/25" microcomputer, a standard "CAMAC" interface and specially-developed program-controlled measurement instrumentation are all employed in the measurement process. The interferometer was an acoustical tube in a vertical configuration with two separate sections. The cover on the lower end contains the primary radiator which produces the acoustical field in the tube. The cover on the upper end of the second section contains a radiator which produces the monitored acoustical load on the test object. This object is placed at the upper end of the lower tube section. Hydrophones then record the acoustic field within the tube. Measurement results from numerous tests using this equipment setup are provided

in graph form. This interferometer configuration makes it possible to reduce measurement complexity and data processing and also improves to some degree the measurement accuracy by accounting for the dependence of acoustic velocity and attenuation on frequency and the experimental conditions.

**Amplitude-Phase Method for Impedance Measurements of Acoustical Systems in the Low-Frequency and Ultrasonic Bands**

907K0107E Moscow IZMERITELNAYA TEKHNIKA  
in Russian No 12, Dec 89 pp 43-44

[Article by K.A. Velizhanina, D.A. Dudkin, K.L. Khirnykh]

[Abstract] This study proposes a fundamentally new method of measuring the impedance of acoustic absorption systems at low ultrasonic frequencies by measuring

the phase and amplitude differences of pressures at specific points in the device, thereby permitting measurements at arbitrarily low frequencies. The method configuration includes a closed working volume loaded into a resonant absorber test specimen. The specimen consists of a perforated panel and a cavity. Lumped parameters of the test volume and the test system are assumed. The measurement process then involves measuring pressure amplitudes at two points and the phase shift between signals at these points to obtain the impedance of the test specimen. This methodology has a number of advantages in that from the theoretical viewpoint it has no lower frequency limit. Measurements can also be conducted not only at discrete frequencies, but also over continuously tunable frequencies. Additionally the method can be employed to analyze the acoustical properties of resonant acoustic absorbers for entire systems rather than their component elements. The method does, however, have an upper frequency limit as the system parameters cease to be lumped at sufficiently high frequencies. The technique can find application to impedance measurement of materials as well including fibers, porous layers, meshes, etc. placed within the cavity.

**The Current Saturation Mechanism in Submicron Emitter Systems**

907K0001D Moscow MIKROELEKTRONIKA  
in Russian Vol 18 No 9, Sep 89 pp 428-433

[Article by V.E. Germ, N.V. Mileshkina, Ye.A. Semykina]

[Abstract] High density current flows cause the nonstationary, nonequilibrium electron processes in a field-effect semiconductor emitter. Such high carrier concentrations occur in the surface space charge region of the field-effect semiconductor emitter. The study develops a program that makes it possible to recover the dynamic and static properties of this emitter. Plots of the average stationary electron drift of GaAs at 300

K as a function of the electrical field strength in a semiconductor bulk are provided; the analyses are consistent with previous theoretical calculations. The static I-V characteristics are simulated by applying fixed yields and measuring the resulting steady-state emissive currents. The I-V characteristics obtained from the computer simulation are also provided. A saturation region is identified in the I-V characteristics and an analysis of the calculation results suggests an origin of the emissive current saturation: these arise due to the drift velocity reaching saturation in the specimen bulk. The method developed in this study makes it possible to employ a single approach to analyze various operating conditions of the emitter, including the linear rise of emission current and the saturation conditions of the I-V characteristics.

**Remote Control and Monitoring of a Telegraph Network***907K0123A Moscow VESTNIK SVYAZI in Russian  
No 1, Jan 90 pp 24-26*

[Article by R.D. Abramov]

[Abstract] This study describes the design and incorporation of a remote control and monitoring unit for use on terminal telegraph equipment; the unit permits total automation of measurement and monitoring operations of the terminal equipment and the communications channels on a switched telegraph network for maintenance and diagnostic purposes. The device employs a single-board microcontroller with a program package and is connected to the subscriber panel of a subscriber telegraph-intermediate exchange-data transmission exchange within the terminal bay. The unit is used to measure individual start-stop distortions, the degree of distortions, and the telegraph transmission rate and to monitor the correction capability of the receiver as well as the autoresponse availability and format. The unit operates in two primary modes: a comprehensive diagnostic monitoring mode which is used to monitor the primary performance characteristics of the terminal unit and a parameter measurement mode. The specific mode is selected by the user by transmitting special commands whose list is provided in the article.

**An Elevated Throughput Capacity Message Switching Electronic Telegraph Concentrator***907K0123B Moscow VESTNIK SVYAZI in Russian  
No 1, Jan 90 pp 30-31*

[Article by A.A. Kachan, M.A. Sosorev]

[Abstract] The design and introduction of the first message switching node based on an electronic telegraph concentrator is presented here. The message switching electronic telegraph concentrator is designed for use on the general purpose telegraph network. The hardware and software capabilities of the concentrator supports up to 128 telegraph communications channels and a throughput capacity of up to a single telegram per second which satisfies the demands of most regions of the country. The specific configuration recommended for use is a message switching node that includes two message electronic telegraph concentrators. A maximum of 256 channels can be connected to a twin concentrator unit. According to preliminary estimates up to 16 channels can be used to interconnect the two concentrators. The twin message switching electronic telegraph concentrator is best employed at telegraph communications nodes where a throughput capacity of up to 1.6 telegrams per second into a total capacity of 240 signals is required.

Under such conditions the twin message switching electronic telegraph concentrator unit will be efficient on all regional nodes with the exception of nodes where message switching centers are best utilized.

**Electronic Control for a Postal Package Bay***907K0123C Moscow VESTNIK SVYAZI in Russian  
No 1, Jan 90 pp 34-37*

[Article by V.N. Dolenko]

[Abstract] The design and application of a mechanized postal package bay employing an electronic control system and its present use in six communications facilities in Dnepropetrovsk are discussed. The electronically-controlled postal package bay is designed for mechanization of both the handling and storage of packages received from clients. The package bay consists of a control panel, weights, transporters, roller tables, a control panel, a bunker, an observation window, a cutoff device and photocells. The equipment configuration in the bay is shown together with a block diagram of the electronic control unit. The electromagnets attached to the support plates form a  $16 \times 16 = 256$  matrix which establishes the capacity of the bay. The electromagnets and transporters are controlled by means of relays and switches on the control panel. The photocells are mounted in front of the weights and in the upper point in the bay allowing for the inertia of the mechanisms. The photocell consists of an AL107B infrared LED and an FT-2K phototransistor with simple 15 mm focusing lenses. The study also provides relevant schematic diagrams of the control panel and associated components as well as pin assignments for the integrated circuits.

**Modernization and Conversion of the Vyaz-M2-OP Transmitter***907K0123D Moscow VESTNIK SVYAZI in Russian  
No 1, Jan 90 pp 39-45*

[Article by G. I. Fridman]

[Abstract] This article is devoted to the modernization and conversion of the Vyaz-M2-OP transmitter to bring the performance and specifications of the transmitter up to modern levels. Previous modifications to the transmitter have made it possible to use the unit for AM radio broadcasting applications. Specific changes in transmitter circuitry to improve sound quality are outlined with detailed schematics of the audio amplifier stage and the bias voltage controls presented for this purpose as well as diagrams of required changes in the lower and upper equipment bays. In addition the article specifies proper voltage levels, wiring changes, and proper output levels as well as appropriate tune-up and testing procedures.

**Experimental Investigation of Nonlinear Distortion in an Acoustooptic Sound Recorder**

907K0089A Moscow *TEKHNICA KINO I*  
*TELEVIDENIYA* in Russian No 11, Nov 89 pp 25-28

[Article by V.V. Vasilev, K.P. Naumov, V.A. Savin]

[Abstract] A detailed analysis of the various factors contributing to nonlinear distortion in a laser-based acoustooptic sound recorder are provided. The nonlinear distortions are divided into optical, acoustooptical, and electrical distortions. The optical scheme of the experimental setup used to analyze nonlinear distortion consists of an LG-50-1 laser (radiation power: 8 mW, wavelength: .63 mcm) which is expanded in the horizontal plane to 5 mm by a cylindrical lens system illuminating a double-slit diaphragm. The diffraction light pattern from the diaphragm is projected by a collimating lens and a rotating mirror onto an ML-201A acoustooptic modulator. The modulator operates in the Bragg diffraction model. The electrical section of the device consists of an FM oscillator controlled by a noise suppression device from a signal recorder, an amplifier-exciter, a photodetector based on an FEU-51 photomultiplier and test equipment designed to analyze operating conditions. The predominant source of nonlinearity in such a design is the optical path. The speckle structure of the laser radiation is primarily responsible for the distortion. Its effect can be reduced by means of high quality optics and by breaking light coherence after the acoustooptical modulator. The nonlinearities of the electrical circuit were found to make a minor contribution to the total harmonic coefficient.

**Multizone Charge Coupled Device Scanners for Natural Resource Exploration**

907K0089C Moscow *TEKHNICA KINO I*  
*TELEVIDENIYA* in Russian No 11, Nov 89 pp 50-53

[Article by A.S. Selivanov, V.A. Timokhin, M.K. Naraeva, M.V. Novikov, O.Ye. Malyuchkov]

[Abstract] This study examines the primary performance specifications and operation of the MSU-E1 (multizone electronic scanning device) three-channel CCD scanner for orbital imaging and analysis in natural resource exploration. The MSU-E1 was placed on board a "Meteor-Priroda" satellite for the tests. Scanners of a similar type are used on the SPOT spacecraft launched in 1986. In the MSU-E1 design the charge coupled device arrays are configured perpendicular to the direction of satellite flight and scan a frame during satellite motion. The unit employs a linear CCD-based photo-detector with 1024 elements per line. A video signal is then taken from the CCD array and is sent to the electronic unit where it is amplified and processed. The study provides a block diagram of the primary components of the MSU-E multizone scanner together with the technical specifications of the unit's electronics. Typical terrestrial images produced by this unit are provided. The photographs reveal arable land, fields, small lakes and rivers, etc. and it is possible to differentiate relative terrain features and objects which makes the system useful for interpretation and decoding of images.

UDC 621.316.1:621.398.001.24

**Asynchronous Telecommunication Systems for Electrical Distribution Networks***907K0118A Moscow ELEKTRICHESTVO in Russian No 12, Dec 89 (manuscript received 23 Jun 88) pp 1-8*

[Article by N.S. Berlin, A.M. Ponomarev, and M.N. Torban]

[Abstract] Asynchronous systems of remote control for electrical power distribution networks over two-way communication channels are considered, to ensure highly reliable arrival of first-class information from a check point while communication from the control room to the check point is broken down. Inasmuch as the speed requirements for data transmission along 6-10 kV distribution networks are moderate, 40-60 s signal travel time from check point to control room being fast enough, asynchronous data transmission with multiple-repeat of messages appears quite promising. Fourfold repeat of messages from a check point has been found to ensure sufficiently reliable communication from three simultaneously monitored check points, but increasing the number of monitored check points is known to lower the efficiency of an asynchronous telecommunication system not only because of cross-attenuation but also because of the longer time required for transmitting series of messages. Three variants of such a system for monitoring up to 10 check points are described and evaluated, each with a different fourfold repeat algorithm. They were tested in three Mozhaisk substations under the Moscow Regional Power System Administration, by simulation of their three modes of operation with the maximum number of check points or with a varying number of check points or with simultaneous activation of all 10 check points respectively. Figures 4; tables 3; references 10.

UDC 621.039.673.018.782.3

**Transient Processes during Programmed Discharge of Capacitive Energy Storage***907K0118B Moscow ELEKTRICHESTVO in Russian No 12, Dec 89 (manuscript received 9 Mar 89) pp 36-41*

[Article by B.E. Fridman, Leningrad]

[Abstract] Programming the discharge of capacitive energy storages so as to match the attendant transient processes with the dynamic processes in the load is considered, the efficiency of discharge being maximized when the load current is built up by sequential transverse switching on the capacitors across the load. The transient processes are considered in this mode of discharge into a resistive-inductive load: the "slow" transient determines the load current and a "fast" charge redistribution transient follows every closing of a switch which adds a capacitor across the load. Both are analyzed in accordance with conventional circuit theory, but each separately. The "slow" transient is approximated by ignoring resistances and inductances in the capacitor battery, whereupon the differential equation describing it is solved by numerical integration as well as by conversion into two finite-difference equations. The latter are simplified when the switching rate is sufficiently high to permit averaging this transient further by replacement of the stepwise increments of capacitance with smooth ones making the capacitance across the load a continuous function of time. Calculations by both methods have been made for programmed discharge with a constant switching rate. The "fast" charge redistribution transient after every switch closing is approximated by disregarding the variation of the load voltage during the charge redistribution process. Analysis of the results reveals additional energy loss during the "fast" transients, also that the amplitude of the internal battery current is higher during programmed discharge than during conventional discharge by simultaneous closing of all switches. Figures 4; references 6.

**Sound Generation by Laser Irradiation of a Semiconductor Surface**

907K0119A Leningrad FIZIKA I TEKHNIKA  
POLUPROVODNIKOV in Russian Vol 23, No 11,  
Nov 89 pp 1976-1979

[Article by A.A. Zakharova, V.I. Ryzhiy]

[Abstract] Two instability mechanisms of a highly disequilibrium semiconductor surface layer system resulting from acoustical perturbations accounting for electron and hole interaction with the acoustical phonons through the deformation potential and the dependence on this quantity are investigated. The deformation instability develops due to the modulation of the deformation potential, the electron-hole plasma concentration from deformation fluctuations and the direct action of the electrons and holes on the lattice through the deformation potential. The deformation-thermal instability, which is the second instability, arises since the modulation occurring from lattice deformation will serve to change the energy transfer rate from the lattice electron-hole plasma and will alter the modulation of  $T$ . It is determined that the laser-irradiated semiconductor layer may produce acoustical oscillations in the lattice when the electron-hole plasma concentration is largely controlled by Auger processes. The conditions and parameters for sound generation by laser irradiation of a surface GaAs semiconductor are reported.

**Ag<sub>Ga</sub>: A New Yahn-Teller Acceptor in GaAs**

907K0119B Leningrad FIZIKA I TEKHNIKA  
POLUPROVODNIKOV in Russian Vol 23, No 11,  
Nov 89 pp 2072-2074

[Article by N.S. Averkiev, A.A. Gutkin, Ye.B. Osipov, V.Ye. Sedov, A.F. Tsatsulnikov]

[Abstract] This study considers the possibility for the existence of Yahn-Teller acceptors in GaAs in addition to the previously-identified Cu<sub>Ga</sub> by analyzing the centers produced in GaAs by silver whose electron structure ( $4d^{10}5s^1$ ) is analogous to that of copper ( $3d^{10}4s^1$ ). The p-type GaAs (Ag) specimens were obtained by Ag diffusion into GaAs at an electron concentration of 5 times  $10^{15} \text{ cm}^{-3}$  in a vacuum deposited layer at temperatures of 800 and 1000°C. The effect of uniaxial pressure  $P$  in the

[100] and [111] directions on the low-temperature photoluminescence band caused by electron-hole pair generation by light and subsequent electron capture by the acceptor level of Ag  $e_v + 0.24 \text{ eV}$  was measured. The spectra of this band measured at 2 k are reported in the study. The study determined that all reported features of low-temperature photoluminescence found in the GaAs (Ag) specimens are qualitatively analogous to the photoluminescence band of the Cu<sub>Ga</sub> center in GaAs. The qualitative differences between the results obtained in this study and analogous relations obtained for Cu<sub>Ga</sub> are explained within the framework of the analysis model.

**Formation of Ordered Structures on a GaAs Surface Under Pulsed Laser Radiation**

907K0119C Leningrad FIZIKA I TEKHNIKA  
POLUPROVODNIKOV in Russian Vol 23, No 11,  
Nov 89 pp 2080-2082

[Article by P.K. Kashkarov, V.I. Petrov, D.V. Ptitsyn, V.Yu. Timoshenko]

[Abstract] This study reports the results from a scanning electron microscopy study of a pulsed laser radiated GaAs surface to investigate the creation and destruction processes of both point and extended defects. p-type GaAs:Si specimens with a (100) surface orientation and p-type GaAs:Zn with a (111) surface orientation were employed in the analysis. A monopulse ruby laser was employed for laser irradiation. The incident laser light was diaphragmed by a steel mask, making it possible to establish a sharp boundary between the radiated and nonradiated sections. The irradiation process occurred in open air at room temperature. A setup based on a JSM-50A scanning electron microscope was used to analyze laser-induced changes in the surface properties of the semiconductors; this unit made it possible to obtain surface images in the secondary electron emission mode and the cathode-luminescence mode. The laser irradiation was found to alter the surface topology of the specimens and the cathode luminescence intensity. Differences were also identified in the nature of laser-induced changes in the semiconductor surface with increasing laser irradiation energy. It is found that pulsed laser irradiation of these GaAs specimens at high energy levels will serve to order the elevated nonradiative recombination regions. This phenomenon will occur only in the (111) surface orientation and is attributed in this study to the nonequilibrium nature of the recrystallization process.

UDC 535.39

**Influence of Nonmonochromatic Periodic Surface Relief on Full Suppression of Specular Reflection of s-Polarized Electromagnetic Wave***907K0176A Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 68 No 1, Jan 90 pp 88-94*

[Article by V. N. Seminogov, V. I. Sokolov]

[Abstract] When light is diffracted from a sine-wave grid with period  $d$  on the same order as the wavelength  $\lambda$ , specular reflection can be totally suppressed if the depth of the relief  $h$  and  $\lambda$  have certain optimal values for the incident angle  $\theta$ . This article derives analytic expressions for the amplitude of resonant-diffracted waves and the coefficients  $R(\theta)$  and  $R(\lambda)$  for diffraction of s-polarized waves on a uniform grating with arbitrary surface shape profile. The influence of nonmonochromatic and asymmetric relief shape on the total suppression of specular reflection is studied. The physical cause of the development of two gaps in  $R(\lambda)$  or  $R(\theta)$  is determined and the conditions necessary for this are found as functions of the optical constants of the material and the surface relief shape. A comparison is presented between the results of the numerical and analytic approaches. Figures 4; References 8: 5 Russian, 3 Western.

UDC 535.2.01

**Possibility of Selecting Forerunner in Propagation of Short Light Pulses***907K0176B Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 68 No 1, Jan 90 pp 105-109*

[Article by F. V. Bunkin, G. A. Lyakhov, et al]

[Abstract] The transition to femtosecond pulses in optics has stimulated interest in the manifestations of unsteadiness in the response of a medium to the propagation of such very short pulses and the practical implementation of effects not previously observed in the optical band. This article discusses conditions under which a Brillouin forerunner can be isolated in the optical band for very short pulses. Explicit expressions are produced describing the deformation of a spectrally limited gaussian pulse with a carrier frequency located between two absorption lines. The conditions of experimental observation of a forerunner are discussed for rubidium vapor. Figures 2; References 16: 7 Russian, 9 Western.

UDC 536.68:535

**Heating by Exciting Light in Optical Experiments***907K0176C Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 68 No 1, Jan 90 pp 110-116*

[Article by L. A. Zubkov, V. P. Romanov, et al]

[Abstract] If a medium has natural absorption at optical frequencies, it is heated as light propagates through it.

This creates a problem when optical methods are used for experiments in the near vicinity of critical points and phase transition boundaries. The problem is greatest in the study of liquid crystals, in which illumination of nematic crystals with visible light significantly changes their physical properties. This article analyzes the distribution of temperature in an absorbing medium. An expression is derived for the distribution of temperature in steady and unsteady cases. The results of computations are compared with experimental data on the distribution of temperature obtained by measurement of the intensity of scattered light in a nematic liquid crystal in an isotropic phase. Solution of the equation for heat conductivity is used to determine the distribution of temperature in a typical geometry by measurement of the intensity of scattered light. The results obtained are compared with experimental results. Measurements are performed in an isotropic liquid crystal in the vicinity of the point of transition to the nematic phase. The effect of heating was recorded by the change in intensity of scattered light at various points in the specimen. The results indicate that local heating during optical measurements may be significant even at low light source powers, but equations are presented for consideration of the effect in both steady and unsteady cases. Figures 3; References 14: 9 Russian, 5 Western.

UDC 535.36

**Scattering of Electromagnetic Waves on Spherically Symmetrical Particles in Naturally Gyrotropic Medium***907K0176D Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 68 No 1, Jan 90 pp 122-127*

[Article by A. N. Godlevskaya, V. N. Kapshay]

[Abstract] The scattering of electromagnetic waves on spherical objects has been studied in many previous works, some of which have considered the optical activity of the scattering body while assuming the surrounding medium to be nongyrotropic. This article solves the boundary-value problems of scattering of electromagnetic waves of particles which have spherical symmetry (on a dielectric gyrotropic sphere, on a two-layer particle with a metal core and a gyrotropic shell) located in an isotropic, naturally gyrotropic, nonabsorbing medium. The scattering, absorption and attenuation cross sections are determined and the behavior of the scattered field in the far zone is analyzed. Precise solutions are produced for the scattering of electromagnetic waves in a naturally gyrotropic isotropic medium containing a single scattering center with spherical symmetry. The asymptotic behavior of the solutions obtained is studied. The results allow the construction of scattering indices for the centers studied and can be used in calculation of a field scattered by a set of particles in a gyrotropic medium. References 18: 15 Russian, 3 Western.

UDC 535.36

**Averaging Effect of Receiving Apertures in Measurement of Scattered, Partially Coherent Radiation**

907K0176E Leningrad OPTIKA I SPEKTROSKOPIYA  
in Russian Vol 68 No 1, Jan 90 pp 128-133

[Article by L. A. Glushchenko, I. A. Popov]

[Abstract] A speckle picture arises when coherent radiation is reflected from an optically rough surface. This article utilizes a strict approach formulated by J. C. Dainty to study the variation in dispersion of the fluctuations of the illumination at the center of the entrance aperture with the shape and dimensions of receiving apertures as well as parameters representing the degree of coherence and spatial distribution of power of the beam illuminating the rough surface. The distribution function of fluctuations of the illumination across the receiving aperture is approximately described by the gamma distribution, and precise solutions are possible in many cases. The beam illuminating the rough surface is approximated by the Shell model of a gaussian beam. Calculations are based on analysis of the power spectrum of spatial illumination frequencies in the plane of various types of receiving apertures: circular, square, including with a central dark spot, as well as an aperture with a gaussian diaphragm. The shape of the receiving aperture, degree of coherence and dimensions of the illuminating beam are thus studied for their influence on the dispersion of fluctuations of the mean level of illumination of the entrance aperture. The data can be used to obtain quantitative estimates of the dispersion of the fluctuation of illumination across the receiving aperture

upon measurement of diffusely reflected partially coherent radiation and can be used to predict the reproducibility of measurements, to estimate the danger of scattered laser radiation for vision and in many other applications. Figures 3; References 18: 12 Russian, 6 Western.

UDC 535.89

**Acoustical-Electrooptical Modulator**

907K0176F Leningrad OPTIKA I SPEKTROSKOPIYA  
in Russian Vol 68 No 1, Jan 90 pp 205-207

[Article by V. N. Belyy, A. G. Mashchenko, et al]

[Abstract] Studies of the acoustical-electrooptical effect of body and surface acoustical waves have demonstrated that the use of acoustical-electrooptical interactions can form the basis for processing of signal information in two independent channels. This article studies the acoustical-electrooptical interaction in the mode of multiple scattering of light by sound in tetragonal crystals when the main axes of anisotropy induced by the field and by elastic deformation coincide. An acoustical-electrooptical cell was manufactured of KDP crystal as a rectangular block measuring 5 x 5 x 26 mm. Flat electrodes were applied to the edges and connected to a voltage source. A light beam from a helium-neon laser with a wavelength of 0.63  $\mu\text{m}$  was diffracted by a standing acoustical wave in the cell, with three diffraction maxima. The device performed amplitude and polarization modulation of the light diffracted by the ultrasound. The modulator is thus suitable for use in signal information processing systems, optical communications lines and light distance measuring devices. Figures 2; References 6: 3 Russian, 3 Western.

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